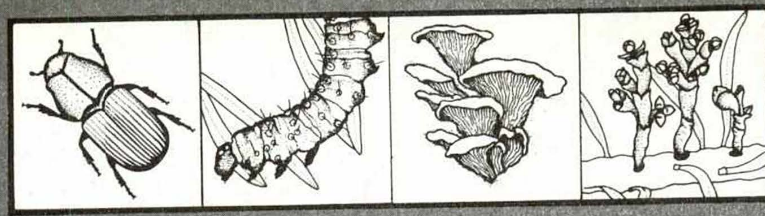
Forest Pest Management



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USE OF TRAP TREES FOR THE REDUCTION OF SPRUCE BEETLE-CAUSED MORTALITY IN OLD-GROWTH ENGELMANN SPRUCE STANDS IN THE NORTHERN REGION

by

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INTRODUCTION

Outbreaks of the spruce beetle (*Dendroctonus rufipennis* [Kirby]), have at times decimated stands of old-growth Engelmann spruce (*Picea engelmannii* Parry) in the western United States. In Canada and Alaska it is also a major pest of white spruce (*P. glauca* [Moench] Voss) and Sitka spruce (*P. sitchensis* [Bongard] Carr.). Less frequently, blue spruce (*P. pungens* Engelmann) is also attacked (Schmid and Frye 1977). Epidemics--most commonly associated with stand disturbances such as windthrow, storm breakage, or logging residuals--occasionally build in standing live trees and kill millions of trees before beetle populations naturally subside. Recorded outbreaks have resulted in spruce mortality totaling billions of board feet. Infestations usually decline after a few years from the combined effects of weather, natural enemies and host resistance. Before that happens, however, spruce stands may be drastically affected. In an extreme case, recorded in an Alaskan white spruce stand, mortality averaged 65 percent of the live spruce (over 5 inches d.b.h.) on more than 70,000 acres (Baker and Kemperman 1974). Average mortality estimates from past outbreaks indicate that in any particular infestation, stand basal area may be reduced by less than half--but residual surviving spruce would be of small diameters (Schmid and Frye 1977).

Though standing live trees are readily killed when beetle populations are high, beetles prefer downed material to standing trees (Schmid 1981). Downed trees, particularly those in shaded locations, offer a much more favorable environment for beetle attraction and brood development. Such trees are usually covered by snow in winter which offers developing broods significant advantages over those in standing trees--insulation from severely cold temperatures and protection from woodpecker predation.

This preference for downed trees provides land managers with an excellent opportunity to manage beetle populations in infested and susceptible stands through the use of trap trees. Trap trees are essentially manmade "blowdown" with the advantage of being placed where access facilitates its removal. Large-diameter spruce, dropped so the bole remains shaded, left unlimbed and unbucked, will attract 8 to 14 times the number of attacking beetles as a similar-sized standing tree (Schmid and Frye 1977). When trap trees are dropped in an appropriate ratio to standing infested trees--and that ratio varies, according to Schmid[1] with number and size of infested trees--they can be an integral part of an overall stand management strategy. Coupled with removal of infested and highly susceptible green spruce, a trap tree program can effectively reduce or eliminate the threat of future losses to the beetle.

SPRUCE BEETLE MANAGEMENT IN OLD-GROWTH SPRUCE

A major first step in the management of spruce beetles in susceptible stands is the recognition of the risk of that stand to beetle attack. While epidemic beetle populations have devastated stands of various characteristics, certain stand conditions have been found to contribute more to rapid population buildups than others (Schmid and Frye 1976). Spruce stands exhibiting the highest potential for spruce beetle outbreaks are those growing on well-drained sites in creek bottoms, those with an average diameter of live spruce (over 10 inches d.b.h.) greater than 16 inches d.b.h., basal area of more than 150 ft^2/acre, and proportion of spruce in the canopy exceeding 65 percent. Hard et al. (1983) have recently determined slower than average radial growth rate may also help distinguish stands with higher susceptibility to beetle attack. As stand conditions differ from those identifying high risk, i.e., reduced basal area, improved growth, etc., corresponding risk category is lower.

Once spruce stands have been rated for risk to beetle outbreaks, management efforts should be directed to those of highest risk first. Alexander (1973) described modifications to management practices imposed by spruce beetle populations. He maintained that if beetles are present in a stand to be treated or in adjacent ones at low levels, and less than the percentage of basal area scheduled for removal is in susceptible trees, any attacked and all susceptible trees should be cut in the first entry. This will usually mean the removal of most large-diameter spruce which may increase windfall risk and favor less desirable tree species, depending on local conditions. Future entries will have to be scheduled in accordance with the need to salvage attacked trees, windfall potential, susceptibility of remaining trees to beetles, and regeneration needs.

On the other hand, if more than the recommended percentage of basal area to be removed is in susceptible trees, the land manager has three options: remove just the susceptible trees; remove as many attacked and susceptible trees as possible, accepting the risk of future mortality; or leave the stand uncut. If the stand is partially cut or left uncut, probably less than half the remaining spruce basal area would be killed, but most surviving spruce would be of smaller diameters.

[1] Schmid, J. M. Personal communication.

If an epidemic infestation is present in the stand, the manager has the option of clearcutting where acceptable, partial cutting, or not cutting at all. If partial cutting or not cutting is the preferred alternative, the manager must accept the risk of a beetle outbreak which may destroy most merchantable spruce in that stand and threaten adjacent ones as well.

Even in the absence of spruce beetle threats, Schmid and Frye (1977) suggest a "beetle management policy" be developed for old-growth spruce stands. In some stands, certain resource considerations may result in letting beetle infestations run their natural course. Those in which beetle populations would be managed should be rated for beetle susceptibility and then silviculturally treated on a highest priority basis. One should realize, however, that spruce beetle populations, naturally occurring in old-growth spruce stands, can build rapidly following stand disturbances. These disturbances, windthrow for example, are impossible to predict.

It is because of these inherent difficulties associated with old-growth spruce management, that a trap tree program can have such practical utility as a mangagement tool. Trap trees are living, merchantable-sized spruce felled to attract attacking spruce beetles (Nagel et al. 1957). Their main purpose is to attract beetles away from living, standing trees and concentrate brood populations into areas where the attacked trees, and the brood they contain, can be removed, or treated, prior to beetle emergence.

Trap trees, of large diameters, properly spaced and shaded, effectively attract beetles for up to one-quarter mile. Their effectiveness is lessened past that distance. We also know that trees dropped in the spring, prior to beetle flight, are more attractive to beetles than those dropped the preceding fall (McComb 1953). Even though spring snow depths may make the felling of trap trees more difficult, it is still desirable to drop them just before beetle flight. Where snow conditions permit, an alternative is to drop the trees leaving an 8- to 10-foot stump. The stump may also be infested and, if so, will have to be removed with the remainder of the tree. That will entail an extra cut in the process, but the stump will produce a usable product.

The trees should be felled in the shade as the beetles avoid boles which are heated and lit by full sunlight (Nagel et al. 1957). Trees should also be left unbucked and unlimbed to hold the trees off the ground, restrict fungal development, lessen drying and contribute to increased shade on attacked surfaces. Limbed and bucked trees, while easier to handle, may settle into the duff, precluding attacks on the bottom surface of the log--the surface most preferred by beetles (Schmid and Frye 1977).

Trap trees should be dropped singly or in two- to three-tree groups. While that strategy will make trap tree removal more time consuming, that "cost" will be offset by the "benefit" of trapping a higher percentage of existing beetle populations. Trap tree placement will depend upon the extent of infestation and local stand conditions. Where small infestations exist, trap trees should encircle the infestation. Larger infestations should have trap trees dispersed throughout as much as possible, as well as along the periphery. Placement may depend upon the silvicultural prescription for the stand, availability of access, etc.

The number of trap trees necessary for a particular infestation will depend upon the number and size of currently infested trees, the existing beetle population, and the size of green trees available to serve as traps. Trap trees will attract many more times the amount of beetles a standing tree will, so the number required will be fewer than infested ones. In the past, researchers have recommended several ratios of trap to infested trees--from 1:10 to 1:2 (Nagel et al. 1957, Wygant 1960). Schmid[2] recommended an assessment of the current beetle population, size of infested trees and size of green trees available to serve as traps. From that information, the number of trap trees can be determined. Schmid maintained that the ratio of trap to infested trees will usually range from 1:5 to 1:2.

Finally, trap trees should be among the largest diameter, green trees available. The larger the trap, the more beetles it will absorb. The more beetles absorbed in a single trap, the fewer traps necessary for a particular infestation. Also, in felling the largest trees, the susceptibility of the stand is reduced.

Recent developments on the commercial availability of pheromone/terpene baits suggest the possibility of enhancing the attractiveness of trap trees through their use. Baited trap trees would have some advantages over unbaited ones, principally in the number of beetles attracted to an individual tree and an increased effective trapping distance. Both these attributes should result in a reduced number of trap trees needed in a particular area. During 1984 we plan to use baited trap trees in order to compare their effectiveness relative to unbaited ones.

A caution issued with the recommendation to use trap trees is the need for their timely removal. Should trap trees be dropped and not removed from the stand prior to beetle emergence, both the extent and the intensity of the infestation will likely be increased. Throughout most of its range, the spruce beetle has a 2-year life cycle. Brood which develops from attacks made in the spring of the year usually will not initiate new attacks until 2 years later. Our recommendation, however, is that traps dropped in the spring should be removed the fall of the same year. The sooner (after beetle flight) the trees are removed, the better--for several reasons: if programed in the same year, the plan is more likely to be followed; traps will be easier to find after only a few months; and the risk of early flight resulting from 1-year beetle development in an abnormally warm summer is eliminated. In some locations, 1-year life cycles may be common; and the sooner a cut tree is marketed, the higher its value. We cannot emphasize too strongly that once traps are dropped and attacked, they must be removed or treated.

The possibility of using "lethal" trap trees is one alternative to trap tree removal. Lethal trap trees are ones treated with chemicals prior to, or at the time of, felling. These chemicals kill attacking beetles or developing brood and eliminate the need for the tree's removal. A number of years ago, researchers found limited success by treating trees prior to felling with the herbicide cacodylic acid (Frye and Wygant 1971, Buffam 1971, Buffam et al. 1973, Lister et al. 1976). The use of cacodylic acid in that manner, however, does not have

[2] Schmid, J. M. Personal communication.

current EPA registration. Another approach, involving the use of carbaryl applied to felled and pheromone-baited trap trees, may be tried on an experimental basis in the spring of 1984. That strategy holds promise, but recommendation for operational use would be premature.

USES OF TRAP TREES DURING CURRENT SPRUCE BEETLE OUTBREAKS

Large amounts of spruce blowdown, occurring during the winters of 1978 through 1980, resulted in several spruce beetle epidemics in northern Idaho and northwestern Montana. Beginning in August 1981, spruce beetle surveys on the Bonners Ferry Ranger District (RD), Idaho Panhandle National Forests (NF's); Glacier View RD, Flathead NF; Fortine RD, Kootenai NF; Boulder Basin, Flathead Indian Reservation (IR); and Stillwater State Forest, Montana Dept. of State Lands, indicated massive population buildups with resulting standing tree mortality (figure 1). Our recommendations to the several land managers involved were the initiation of silvicultural practices to reduce stand susceptibility, the sanitation harvest of infested trees, and the implementation of an extensive trap tree program. Following is a description of the infestations, management programs developed, and results.

Bonners Ferry RD

In August 1981, surveys conducted on the District indicated severe infestations in several drainages (Gibson and Oakes 1981). Beetle populations had developed in undetected blowdown which occurred during 1978 and 1979. Because of the extent of the infestation when first detected and concern for critical grizzly bear and caribou habitat, management opportunities were limited. An interdisciplinary team developed a comprehensive plan of removing infested and susceptible trees in a series of small clearcuts and partial cuts. In addition, trap trees were utilized in several locations where partial cutting was desirable. In Blue Joe Creek, 50 trap trees were felled in 10 groups scattered throughout the infested area. The trees were dropped in early May 1982. Evaluations during that summer showed heavy spruce beetle attacks on all downed trees. Trap trees were subsequently removed in July 1982. A walk-through survey conducted the following summer (1983) revealed no newly attacked trees throughout the treated area.

Trap trees were used in two other areas on the District in conjunction with current timber sales or continuing salvage programs. In the Silver Saddle Timber Sale area, 22 of the largest diameter spruce were dropped as traps in early spring 1982. They were removed in September 1982. All traps were infested and the infestation in standing trees has been virtually eliminated.

Sixteen trap trees were felled in one 15-acre unit of the Amkan Timber Sale area (American and Canuck Creeks) where periodic salvage programs attempted to remove recent beetle-killed trees. They were dropped in April and May 1983, and removed in September 1983. All trap trees were heavily infested at the time of their removal. Followup evaluations will be made in 1984; however, no newly attacked standing trees were observed in the area in 1983.

1. Bonners Ferry RD
2. Glacier View RD
3. Fortine RD
4. Flathead IR
5. Stillwater SF

Figure 1. Locations of spruce beetle infestations and trap tree programs in Northern Region, 1982, 1983, and 1984.

Beetle infestations remain in drainages not yet entered. However, in those areas where stands have been treated through the use of partial cuts, sanitation, and trap trees beetle populations have been reduced to an insignificant level. Timely and judicious cutting practices have helped reduce beetle-caused mortality, lessen future risk of beetle infestation, and maintain critical big game habitat on the District.

Glacier View RD

Surveys conducted in August 1981 indicated high and still increasing beetle populations in several drainages (McGregor et al. 1981). Management recommendations for the District were similar to those outlined for Bonners Ferry RD and other areas experiencing spruce beetle infestations: removal of infested and susceptible trees and extensive use of trap trees. Trap trees were used in conjunction with three individual timber sales within the Coal Creek drainage.

The most extensive of the three was the Coal Beetle Salvage sale, along approximately 4-1/2 miles of Coal Creek. In this area, 438 trap trees were dropped from March 15 to 30, 1982. Trees used as traps ranged from 26 to 36 inches d.b.h. The trees were felled in 4- to 6-tree groups and within a tree length of existing roads where possible. All traps were removed from August 10 to 30, 1982. All trees inspected had been infested by beetles.

The other two areas in which traps were used were not logged until winter 1983. In the Snowshoe Salvage Sale, along South Fork Coal Creek, 64 trap trees were used. The trees were dropped singly or in small groups and scattered throughout the sale area along existing roads. Diameters of trap trees ranged from 15 to 30 inches. They were removed between September 1 and September 15, 1983. The final area was the Mathias Creek Salvage Sale along Mathias Creek and the upper portion of Coal Creek. During the period March 10 to 31, 1983, 93 trap trees were felled. Diameters ranged from 20 to 31 inches d.b.h. They were dropped in two- to three-tree groups, and where practicable, along existing roads. The trees were removed from September 1 to 15, 1983. No newly attacked standing trees have been observed in either area. We will conduct surveys in 1984 to determine the overall success of these programs.

Fortine RD

Spruce beetle infestations in the vicinity of Therriault Lakes recreation area were first observed in late fall, 1981. Extensive surveys were conducted in 1982 throughout old-growth spruce stands in that portion of the District. Following a determination of the extent of the infestation and management objectives in that and adjacent areas, alternatives were developed to address those concerns. Those strategies were similar to ones previously detailed--sanitation/salvage of infested and susceptible spruce in small clearcuts and partial cuts and an extensive utilization of trap trees. In five separate sale areas along Wolverine Creek, Bluebird Creek, Rich Creek, Robin Creek, Wigwam River, and around Big and Little Therriault Lakes, 1,376 trap trees were dropped in spring 1983. Following beetle flight, field crews examined the area and found all trap trees infested by beetles. Throughout the treated area, which exceeds 2,100 acres; one standing tree was found to have been successfully attacked in 1983. Overlapping broods

found there result in a beetle flight each year, so additional trap trees will be used in 1984. The success of the trap tree program and the removal of infested trees in 1983 will permit the use of fewer trap trees in 1984. Completion of the program in 1984 should reduce beetle populations to endemic status in that area of the District.

Flathead Indian Reservation

Spruce beetle-infested trees were initially detected on the Reservation in October 1981. Subsequent surveys indicated the infestation was confined to old-growth spruce/subalpine fir stands in the northeastern portion of the Reservation referred to as Boulder Basin. Surveys completed in May 1982 showed about two newly infested trees per acre throughout the area. Despite the lateness of the season, a management program removing infested and highly susceptible spruce, and felling trap trees was initiated on the more than 2,000 acres involved. Contracts were let and, though logging continued through the summer months, 170 trap trees were dropped by June 24. All trap trees were heavily infested, and followup surveys showed few new attacks in standing trees. All traps were removed by November.

Some infested and cull material had been left in the sale areas, and an additional year of trapping seemed prudent. In early May 1983, 140 large-diameter live spruce were felled throughout the sale areas. Inspections during the summer months showed few attacks on the trap trees, and none in standing trees. Though some beetles from the 1982 flight could be present in 1984, we believe the reduction in susceptible and infested trees has reduced the population to endemic levels. Blowdown risk has increased in some partial cut areas, and monitoring of those stands will be necessary. But newly available access will facilitate removal of any subsequent blowdown. Detection and removal of future blowdown should eliminate recurrence of population buildups.

Stillwater State Forest

Surveys to determine the extent of the spruce beetle infestation on the Stillwater State Forest were completed in August and September 1981. A sanitation and trap tree program was begun immediately on about 24,000 acres. Between September 1981 and September 1983, nearly 6.5 MMBF, mostly spruce, were removed in a series of sales. Approximately 890 MBF of that (14 percent of total) was utilized as trap trees. Traps were dropped in both 1982 and 1983, between April 15 and May 15 each year. Trap trees were felled in 10- to 12-tree groups--each group occupying about 1.5 acres. In 1982, 37 such groups were felled; in 1983, 40. Trees used as traps averaged almost 26 inches d.b.h.

Following beetle flight, all trap trees and standing, green, adjacent trees were inspected for beetle attacks. All trap trees were heavily infested and at some trapping sites, standing trees were also attacked, an indication that insufficient trap trees were felled. In one location where beetle populations were highest, standing trees were attacked in the ratio 3:1--standing green attacks to trap trees felled. In most locations, the ratio was much lower. Where beetle populations were lowest, no standing trees were attacked. All

standing trees attacked were within 200 feet of the trap tree group. They were cut and removed with the traps. Infested trees (standing and downed) were removed by mid-September each year. Trap trees will be used again in 1984 on a limited basis where beetle populations exist. The complete program of partial cutting, sanitation, and trap trees has been successful in reducing beetle-caused mortality in infested areas and preventing the spread of beetles into uninfested ones.

CONCLUSION

The use of trap trees for management of spruce beetle populations has been advocated for more than 30 years (Nagel et al. 1957, McComb 1953). Though this strategy has been used successfully on a small scale in various locations in the intervening years, large-scale operational projects have rarely been documented[3]. These recent series of spruce beetle outbreaks have afforded the opportunity to recommend the use of trap trees, observe the success of these programs and record resulting population reductions.

Results of these programs enable us to more confidently recommend the use of trap trees for spruce beetle management. When coupled with the harvest of infested and susceptible trees (which implies reduction of stand risk to beetle attack), trap trees provide an efficient, economical, and environmentally acceptable means of reducing beetle-caused mortality in old-growth spruce stands.

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[3] Schmid, J. M. Personal communication.

REFERENCES

Alexander, R. R. 1973. Partial cutting in old-growth spruce-fir. USDA For. Ser. Rocky Mtn. For. & Range Exp. Sta., Res. Pap. RM-110. 16 p.

Baker, B. H. and J. A. Kemperman. 1974. Spruce beetle effects on a white spruce stand in Alaska. J. For. 72: 423-425.

Buffam, P. E. 1971. Spruce beetle suppression in trap trees treated with cacodylic acid. J. Econ. Entomol. 64: 958-960.

Buffam, P. E., C. K. Lister, R. E. Stevens, and R. H. Frye. 1973. Fall cacodylic acid treatments to produce lethal traps for spruce beetles. Environ. Entomol. 2: 259-262.

Frye, R. H. and N. D. Wygant. 1971. Spruce beetle mortality in cacodylic acid-treated Engelmann spruce trap trees. J. Econ. Entomol. 64: 911-916.

Gibson, K. E. and R. D. Oakes. 1981. Evaluation of spruce beetle in the Blue Joe Creek drainage, Bonners Ferry Ranger District, Idaho Panhandle National Forests, 1981. USDA For. Ser., Northern Region, FPM Rept. 81-19. 6 p.

Hard, J. S., R. A. Werner, and E. H. Holsten. 1983. Susceptibility of white spruce to attack by spruce beetles during the early years of an outbreak in Alaska. Can. J. of For. Res. 13: 678-684.

Lister, C. K., J. M. Schmid, C. D. Minnemeyer, and R. H. Frye. 1976. Refinement of the lethal trap tree method for spruce beetle control. J. Econ. Entomol. 69: 415-418.

McComb, D. 1953. The use of trap trees for the control of the Engelmann spruce beetle, Dendroctonus engelmanni Hopkins. MS Thesis, Utah State Agric. Coll., Logan, UT. 34 p.

McGregor, M. D., K. E. Gibson, R. D. Oakes, J. Chmelik, and M. Mayberry. 1981. Evaluation of spruce beetle, Glacier View RD, Flathead National Forest, 1981. USDA For. Ser., Northern Region. FPM Rept. 81-18. 6 p.

Nagel, R. H., D. McComb, and F. B. Knight. 1957. Trap tree method for controlling the Engelmann spruce beetle in Colorado. J. Forestry 55: 894-898.

Schmid, J. M. 1981. Spruce beetles in blowdown. USDA For Ser., Rocky Mtn. For. & Range Exp. Sta. Res. Note RM-411. 5 p.

Schmid, J. M. and R. H. Frye. 1976. Stand ratings for spruce beetles. USDA For. Ser., Rocky Mtn. For. & Range Exp. Sta., Res. Note RM-309. 4 p.

Schmid, J. M. and R. H. Frye. 1977. Spruce beetle in the Rockies. USDA For. Ser., Rocky Mtn. For. & Range Exp. Sta., Gen Tech. Rept. RM-49. 38 p.

3498

Wygant, N. D. 1960. Use of trap trees for suppression. Unpublished paper. Presented at conference on Engelmann spruce beetle surveys and suppression. March 7, 1960; Ogden, UT. 3 p.